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• PATENT ABSTRACTS OF JAPAN vol. 9 no. 152
(M-391) [1875], 27 June 1985 & JP-A-60 029274
(NAOI SEIKI K.K.) 14 February 1985,

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Description

This invention concerns a honing machine to hone curved and shaped profiles and also the use of the honing machine as set forth in the relative main claims 1, 21.

To be more exact, the honing machine according to the invention is suitable to perform honing operations on profiles which are at least partly curved or shaped and which belong advantageously to furniture elements.

This invention is applied in particular, but not only, to the honing of surfaces of tables, mouldings of furniture or pictures, panels, doors of kitchen cupboards, elements of chairs, etc.

This invention is also especially indicated for the honing of furniture elements leaving the varnishing shop but can be applied also to furniture elements in the raw state without varnish.

The automatic honing machines of the state of the art consist typically of a conveyor surface, on which the piece being processed is fed substantially in a straight line, and of a plurality of processing heads which act in sequence on the piece being fed.

These processing heads generally comprise grinding wheels or abrasive belts, or combinations of wheels and belts, normally installed in succession in a manner coordinated with the surface to be honed.

The position of the processing heads in the honing machines of the state of the art is substantially not changed in relation to the piece being fed.

The type of the processing heads depends on their position on the honing machine as well as on the type, material and profile of the piece being processed.

The first processing heads generally carry out rough-shaping of the piece, whereas the successive processing heads perform the real honing and the last processing heads are equipped for providing a high-quality finish to the piece to be processed.

The most developed honing machines include devices for the automatic take-up of the wear of the grinding wheels, this wear being especially important, particularly so in the case of the grinding wheels providing the final finish.

These devices for take-up of the wear obtain a progressive approach of the grinding wheel in the axial direction so as to compensate the reduction of diameter of that wheel as a result of wear and thus to keep the working pressure substantially constant.

The state of the art does not include specific efficient honing machines to process furniture elements or other products that have an at least partly curved, moulded or variously shaped profile.

The embodiment of such honing machines has always entailed a series of problems linked to the need to ensure an efficient, uniform and constant action of the processing heads on the piece to be honed; other problems have so far prevented the development and embodiment of such a type of honing machine.

Such problems mainly concern the correct and constant positioning of the processing head in relation to the piece to be honed, the compensation of the wear of the abrasive elements, the evenness of the honing action of the processing head at the various points of the shaped profile and yet other problems.

For some time now embodiments of honing machines have been tried for curved and shaped profiles whereby the movement of the processing heads has been performed according to a pre-set set program which tends to re-produce the profile of the piece to be honed, but the results have not been found satisfactory owing to the low reliability and accuracy of the results.

Embodiments have also been disclosed in which grinding and/or lapping devices include at least one feeler means suitable to read the profile of the piece to be processed, or of a template having the same profile as the piece and to condition the means that actuate the honing tool according to that reading.

For instance, the closest prior art EP-A2-0.084.506 discloses a honing machine according to the preamble of claim 1, the machine being suitable in particular to grind the edges of glass sheets or surfaces. This device comprises a feeler means, which is positioned on an arm able to move linearly and is suitable to read the profile of the piece to be ground and to convert that reading into an electrical signal that conditions the drive motor of the grinding tool; this drive motor acts with a pre-set period of delay, which depends on the angle defined by the working axes respectively of the feeler means and of the tool in relation to the piece to be ground and on the relative speed as between the tool and the piece.

This device, however, is not suitable to process pieces having an especially irregular profile characterised by the presence of a plurality of projections and valleys succeeding each other, particularly when such projections and valleys are characterised by extremely small radii of curvature, such as the surfaces of antique-type furniture, for instance. This device, moreover, does not include means for the automatic compensation of the wear of the tool working on the piece, nor does it include means to regulate the speed of rotation and/or the pressure exerted by the tool on the piece according to the characteristics of the profile.

Furthermore, it does not arrange to compensate the intensity of the action of the tool according to its position in relation to the centre of rotation of the piece and therefore according to the relative peripheral speed as between the tool and the piece.

JP-A-60-29274 discloses a device for the grinding of products which includes a feeler means running on the profile of a template corresponding to the profile to be ground, thus inducing mechanically a corresponding movement of a grinding tool associated with the edges of the product.

This feeler means has a truncated-cone conformation and its surface in contact with the profile of the template can be varied to compensate the wear of the

grinding tool.

This device is conceptually, structurally and operationally different from, and unsuitable as compared to, a device performing reading and direct identification of the profile of the piece to be processed, conversion of that reading into an electrical signal and conditioning of the means that actuates the working tool.

Furthermore, the association between the feeler means and the working tool being of a mechanical type, the variation of the vertical position of the feeler means so as to compensate the wear entails a lateral variation of position of the working axis of the tool in relation to the product being processed.

This entails frequent interruptions to re-position the tool and/or product correctly according to such displacements.

US-A-4,525,958 too discloses a grinding device which includes a feeler means that follows the profile of a template and is associated mechanically with a tool acting on the profile of the piece to be processed.

This device too entails the same drawbacks as those mentioned with regard to JP-A-60-29274. Moreover, this device has the purpose of controlling the peripheral speed but not the reciprocal positions.

The failure to develop functionally efficient honing machines for the specific processing of curved and continuously steeply shaped profiles makes necessary at the present time the performance of such operations by hand with resulting high costs as regards execution times and use of labour, and these costs have an unfavourable effect on the end cost of the finished product.

The present applicants, in view of the requests made repeatedly over a long time by operators in this field, began some time ago to design, test and embody a machine suitable to hone furniture elements including an at least partly curved or shaped profile comprising projections and valleys close to each other.

The present invention is the outcome of such design work, testing and embodiment which have been in progress for a long time.

This invention is set forth and characterised in the respective main claims 1, 21, while the dependent claims describe variants of the idea of the main embodiment.

The purpose of the invention is to provide a honing machine suitable to hone furniture elements such as mouldings, cupboard doors, surfaces of tables, etc., which have a curved or variously shaped profile.

This invention is especially suitable to hone pieces the profiles of which include a plurality of projections and valleys, which succeed each other continuously, particularly when characterised by small radii of curvature, such as in particular the surfaces of antique-type furniture.

The invention comprises means to displace the furniture element to be honed, such means being suitable to bring the whole profile of the furniture element progressively into cooperation with the processing assembly

or assemblies with which the honing machine is equipped.

In a first embodiment of the invention, which is especially suitable for the processing of the surfaces of tables, the displacement means are of a turntable type and consist, for instance, of a rotary table. This turntable cooperates with means that keep the furniture element in position during the processing.

The means to keep the furniture element in position consist, in a first embodiment, of thrust means that act on the furniture element from above.

According to a variant the turntable includes aspiration means, which are set to work after the positioning of the furniture element and create a negative pressure that acts on the furniture element during the processing.

Where the displacement means are of a turntable type, the processing assemblies are fitted to shafts which can be moved advantageously in a radial direction in relation to the axis of rotation of the turntable.

According to a variant of the invention the displacement means are of a linear type and the processing assemblies are arranged at the side of the axis of feed of the furniture element being processed.

According to the invention a processing assembly comprises at least one assembly to read the profile, at least one operating unit and one governing and control unit.

The profile-reader assembly may be one single assembly for all the operating elements of the honing machine or one profile-reader assembly may be included for each of the operating units.

In a first embodiment of the invention the profile-reader assembly is of a type carrying out mechanical reading and including a feeler unit comprising at least one feeler element.

According to a variant the profile-reader assembly is of a type performing optical reading and comprises, for instance, an ordered series of photoelectric cells or laser sensors, or else one or more telecameras, or else a series of scanners or other like devices performing optical reading.

With reference to the direction of feed of the piece being processed, whether the direction be substantially circular or substantially linear, the profile-reader assembly is positioned advantageously upstream of the relative operating unit at a determined reciprocal position.

According to the invention each operating unit comprises an operating element which can move in relation to the piece to be honed. This operating element may consist, depending on the case in question, of a grinding wheel, an abrasive belt fitted to rollers, an abrasive belt fitted to rollers and cooperating with a thrust pad in the vicinity of the zone of contact, or another means suitable for the purpose.

The operating unit is governed advantageously by control means able to cause the operating element to carry out inversions of direction in approaching and departing from the piece in very short times.

The operating element includes abrasive means driven by a motor, the speed of which can be adjusted and advantageously be controlled electronically.

According to a variant the pressure too of the abrasive means against the piece to be honed can be adjusted and advantageously controlled electronically.

The honing method according to the invention provides for a step of identification and reading, performed by the profile-reader assembly, of every position of the profile of the piece to be honed together with storage and transfer of the relative data to the governing and control unit.

The governing and control unit conditions actuation of the operating unit with a period of delay which is a function of the distance by which the profile-reader assembly and relative operating unit are separated, and also of the relative speed of feed of the piece.

Where a plurality of operating units are governed by one single profile-reader assembly, the governing and control unit conditions the actuation of each operating unit with a relative distinct delay time, which is a function of the distance between the profile-reader assembly and the single operating unit and also of the relative speed of feed of the piece.

In this way the honing machine according to the invention achieves a continuous survey, performed directly on the piece itself, of the data relating to the profile of the piece to be honed and also the transfer of such data to the tool or operating element which has to work on that profile, with a resulting governing of the position of the operating element in relation to that profile.

Thus a constant, accurate and correctly timed positioning of the operating element is ensured, and the operating element can thus follow any type of curve, union, hollow or shaping on the profile.

The feeler element of the feeler unit is a means able to move in relation to the piece to be honed; this feeler element during processing is brought into contact with the periphery of the profile of the piece to be honed.

The displacements of the feeler element induced by the piece to be honed are stored by the governing and control unit, which thus determines in each case the actual profile of the piece and conditions in that way the actuation of the means that displace the operating element.

According to the invention the honing machine includes means suitable to carry out steps of automatic compensation of the wear of the operating element, especially of the grinding wheel, for such wear determines a reduction of the diameter of the operating element itself.

In a first embodiment of the invention these steps of automatic compensation of the wear are obtained by employing a special conformation of the feeler element.

An advantageous conformation of the feeler element, which is suitable to obtain compensation of the wear, is substantially a tapered or a truncated-cone

conformation with its axis parallel to the nominal plane of the zone to be honed on the piece to be honed.

According to this embodiment the zone of contact of the feeler element with the profile of the piece to be honed is progressively varied according to the progressive reduction of diameter of the operating element.

At the start-up of processing the feeler element is brought into contact with the profile at a dimension thereof correlated with the dimension of the operating element.

As processing proceeds, the axial position of the feeler element is altered continuously or periodically at pre-set intervals so as to bring progressively into contact with the profile of the piece to be honed a surface of a gradually smaller diameter consistent with the reduction of the diameter of the operating element.

Compensation of the wear of the operating element enables the performance of the honing machine in terms of a constant and uniform action to be improved.

The frequency and amount of the dimensional variation of the feeler element can be optimised by equipping the governing and control unit with data banks relating to the quantification of the wear of the operating element in relation to its type and to the type of the piece to be honed, to the type of processing carried out, etc.

According to a variant the governing and control unit is associated with means to monitor directly the wear of the operating element, such means conditioning a continuous or periodical corrective action of the governing and control unit to determine a variation of the surface of contact of the feeler element, such variation being consistent with the monitoring of the wear on the operating element.

According to another variant the compensation of the wear on the operating element is achieved according to a fully automated procedure, starting from the data of wear of the operating element, whether these data be stored by the governing and control unit according to pre-determined tables as a function of the processing parameters, or whether these data be monitored directly during the processing itself.

On the basis of these data the governing and control unit alters the parameters of actuation of the operating element, according to the progressive wear of that element, by acting on the speed of rotation of the element, on the radial and/or lateral displacement of its supporting arm and possibly also on the inclination of its axis, so as to keep the honing action constant and uniform as the processing proceeds.

According to a variant at least one second feeler unit is included upstream of the first processing assembly of the honing machine according to the invention.

This second feeler unit is specifically suitable to monitor projections and valleys along the profile of the piece to be honed and also the radius of curvature thereof and conditions therefor the speed of rotation of the operating element and/or the pressure thereof against the piece and/or possibly also the speed of feed

of the piece to be honed, thus conditioning the strength of the honing action of the operating element on the piece according to such monitoring.

This second feeler unit may be one alone and may govern all the processing assemblies of the honing machine according to the invention.

According to a variant each processing assembly comprises both the profile-reader assembly and the second feeler unit.

According to a further variant the second feeler unit also acts as a profile-reader unit.

The inclusion of the second feeler unit makes it possible to obtain compensation of the specific interval of time, during which the operating element acts on a specific segment of the profile of the piece to be honed, according to the geometric and structural characteristics of the profile of the piece to be honed.

The inclusion of projections and valleys, in fact, causes a greater and shorter stay time respectively of the operating element in contact with a given segment of the profile of the piece.

The longer the stay time of the operating element at a projection, such stay time being proportionately as much longer as the radius of curvature is smaller, will determine too intense an action of the operating element, so much so that, where there are pointed prominences or rounded protrusions with a small radius of curvature, the removal of such prominences may take place.

Viceversa, the shorter stay time of the operating element at a valley may lead to too gentle a honing action.

According to another variant the governing and control unit comprises means to identify the presence of projections and valleys on the profile of the piece to be honed and also the radius of curvature thereof directly as a result of the monitoring performed by the profile-reader assembly.

According to yet another variant means are included to compensate the honing action of the operating element according to its approach to or distancing from the axis of rotation of the turntable, as determined by the conformation of the piece and/or by the presence of projections and valleys on the profile.

The approach to or distancing from the axis of rotation causes, in fact, a variation of the peripheral speed of the piece, which has to be compensated by taking action on the speed of rotation and/or on the pressure of the operating element according to the identification of that distance.

The attached figures are given as an example and show some preferred embodiments of the invention as follows:-

Fig.1 is a three-dimensional view of a form of embodiment of a honing machine for curved and shaped profiles according to the inven-

Fig.2

Fig.3

Fig.4

Figs. 5a 5b and 5c

Fig.6

Figs. 7a and 7b

Fig.8

Figs.9 and 10

tion;

shows a working diagram of the second feeler unit according to the invention;

is a diagram of the honing machine with displacement of the piece by a turntable;

shows the honing machine with linear displacement of the piece;

show the process of compensation of wear of the operating element;

shows a variant which includes the first and second feeler units incorporated in one single feeler unit;

show two working steps of the feeler unit of Fig.6;

is a diagram of a variant of Fig. 4; show possible examples of the embodiments of units for optical reading of the profile.

Fig.1 shows a possible form of embodiment of a machine 10 to hone curved or shaped profiles according to the invention, the machine being of a type in which a piece 11 to be honed is rotated on a turntable and the machine provides reading of a mechanical type of the profile of the piece 11.

The piece 11 to be honed in this case consists of a surface of a table 111 and is positioned on a turntable 12 fitted to a base 13 and cooperating at its lower side with drive means 14.

During processing, when the surface of the table 111 has been positioned on the turntable 12, a thrust element 15 is lowered onto the surface of the table 111 and keeps it rigidly in position.

According to a variant which is not shown here, the turntable 12 includes in its lower portion aspiration means, which create a negative pressure against the piece 11 to be honed and retain the same on the turntable 12 during the whole processing.

A plurality of processing assemblies 16 cooperate with the periphery of the surface of the table 111.

For the sake of convenience of illustration Fig.1 shows only one of the processing assemblies 16, but a plurality of substantially equal processing assemblies 16 may be included and be arranged at a distance apart in cooperation with the periphery of the piece 11 to be honed.

In the embodiment of Fig.1 each processing assembly 16 consists of a reader assembly 17 to read the profile, the assembly in this case consisting of a first feeler unit 117 and an operating unit 18; the first feeler unit 117 is located upstream of the relative operating unit 18 according to the direction of rotation or feed of the piece 11 to be honed.

The first feeler unit 117 and operating unit 18 are

arranged radially in relation to the piece 11 to be honed when that piece 11 is rotated on a turntable (Fig.3), and perpendicularly to the axis of feed of the piece 11 where that piece 11 is moved in a linear manner (Fig.4).

A second feeler unit 19, the function of which will be explained hereinafter, is included upstream of the first processing assembly 16 in this case and is fitted to an independent supporting and actuation assembly, which is not shown in the figure.

The first feeler unit 117 comprises a feeler element 20 fitted to an arm 21 solidly associated with a first movable carriage 22, which is guided at its lower and upper ends within a frame 23 and can be moved radially in relation to the axis of rotation of the turntable 12 so as to take the feeler element 20 nearer to or farther from the surface of the table 111.

In this case the first movable carriage 22 is associated with drive means consisting of a piston rod 24 with a pneumatic cylinder 25 and slides on guides 26.

When processing begins, the surface of the table 111 is set in movement and the feeler element 20 is brought into contact with the profile of the table 111 to be processed by means of displacement of the first movable carriage 22.

The surface of the table 111 being rotated induces radial and/or lateral movements in the feeler element 20, thus enabling each position of the profile of the table 111 to be read and identified.

The data relating to that profile are sent to a governing and control unit 27 by means of an encoder associated with the first movable carriage 22.

The governing and control unit 27 processes the data received and transfers them to the operating unit 18 with a delay which is a function of the distance between the positions of the first feeler unit 117 and the operating unit 18 itself and is also a function of the relative speed of displacement of the piece 11 to be honed.

When one single feeler unit 117 is associated with two or more operating units 18, the governing and control unit 27 transfers the relative data of the profile of the piece 11 to be honed with differentiated delays which are a function of the individual distances between the positions of the relative operating units 18 and of the feeler unit 117 and are also a function of the speed of relative displacement of the piece 11 to be honed.

The operating unit 18 has a structure substantially analogous to that of the first feeler unit 117, comprises a second carriage 28 able to move radially in relation to the axis of rotation of the surface of the table 111, is associated with worm displacement means 29 and can slide on guides 30.

In this example the drive means of the second movable carriage 28 comprise a D.C. motor 31 provided with an actuation means.

An honing tool or operating element 32 solidly associated with the second movable carriage 28 and fitted to an arm 41 cooperates with a motor equipped with an inverter and is capable of carrying out the required

operation on the profile of the table surface 111.

The operating element 32 may consist, depending on the case in question, of an abrasive grinding wheel, an abrasive belt fitted to rollers, or an abrasive belt fitted to rollers and associated with a thrust pad or other analogous means.

The governing and control unit 27 controls the actuation of the operating unit 18 according to the data obtained by the feeler element 20 directly on the specific piece 11 to be honed immediately before the honing process.

According to the embodiment shown the feeler element 20 has a conformation suitable to provide mechanically an automatic compensation of the wear of the operating element 32 while processing is proceeding. Such wear entails a reduction of the diameter of the operating element 32, and this reduction, if not compensated, would lead to a weaker and weaker and uneven honing action on the whole profile of the piece 11.

In this example the feeler element 20 has the conformation of a truncated cone with its vertex facing downwards.

According to a variant which is not shown, the feeler element 20 has its vertex facing upwards.

As the processing and the wear of the operating element 32 proceed, the feeler element 20 is raised progressively by the lifting of its arm 22 associated with a screw-threaded means 33 so as to reduce the dimension of the surface of contact between the feeler element 20 and the profile of the piece 11 to be honed.

In this way the data obtained regarding the profile are changed according to the wear of the operating element 32 and according to the reduction of diameter thereof.

Figs.5a, 5b and 5c shows three distinct phases of the axial positioning of the feeler element 20 in relation to the piece 11 to be honed.

The compensation can be carried out continuously or at pre-set periodical intervals, the frequency and length of which can be pre-set on the basis of experimental data relating to the actual wear of the operating element 32.

The truncated-cone conformation of the feeler element 20 with its vertex facing downwards is shown merely as an example but other functionally analogous conformations can be employed provided that they make possible, by means of its displacement on a plane advantageously perpendicular to the plane of positioning of the piece 11 to be honed, a reduction of the diameter of the feeler element 20.

According to a variant the operating element 32 is associated with means that measure wear continuously or periodically, such means being connected to the governing and control unit 27 so as to alter, according to the wear measured, the diameter of the surface of contact between the feeler element 20 and the profile of the piece 11 to be honed.

According to a variant of the invention a second

feeler unit 19 is included upstream of the first feeler unit 117 and has the task of identifying any projections 35 or valleys 34 in the profile of the piece 11 to be honed (Fig.2).

According to a variant the second feeler unit 19 is also able to evaluate the radius of curvature of such projections 35 or valleys 34.

The inclusion of projections 35 and valleys 34 and their more or less accentuated curvatures entail changes in the stay time and in the pressure and dimension of contact of the operating element 32 with any specific segment of the profile of the piece 11 to be honed, the nature of such contact not being punctiform.

Such changes take place in relation to changes in the radii of curvature of the segments of profile affected by the honing action according to the presence of projections 35 and valleys 34, thereby entailing a variation in intensity of the honing action.

To be more exact, a shorter stay time, per unit of linear space, of the operating element 32 at the valleys 34, such time being proportionately as much shorter as the curvature is more accentuated, entails, given an equal speed of rotation of the operating element 32, a honing action which may be too gentle.

Viceversa, a longer stay time at the projections 35, being proportionately as much longer as the curvature is more accentuated, will entail a honing action which may be excessive.

The identification of projections 35 and valleys 34 and their radius of curvature may make possible a compensation of the speed of rotation and/or of the pressure of the operating element 32 in relation to the longer or shorter stay time of that element 32 in contact with a specific segment of the piece 11 to be honed.

A possible embodiment of the second feeler unit 19 is shown in Fig.2.

The second feeler unit 19 consists of three contact elements 36a and 36b, each of which consists of a small ball, roller or slide block fitted to a small articulated carriage 37.

The small articulated carriages 37 are pivoted at 38 on a movable shaft 39, which can move, depending on the situation in question, radially or perpendicularly to the profile of the piece 11 to be honed.

The two outer contact elements 36a of the three contact elements of each feeler element 19 are fitted immovably to their articulated carriage 37, whereas the central contact element 36b is fitted to a further small carriage 40, which is secured to the central articulated carriage 37 and can move in a direction perpendicular to the line joining the centres of the two outer contact elements 36a.

The further small carriage 40 is associated with an encoder which evaluates the sign and extent of the displacements of the central contact element 36b in relation to the reference axis consisting of the line joining the centres of the two outer contact elements 36a.

The data obtained by the decoder has the purpose

of compensating the speed of rotation and/or pressure of the operating element 32 as a function of the presence of projections 35 and valleys 34.

In other words, the speed of rotation and/or the pressure of the operating element 32 take on a determined reference value corresponding to the situation of a substantially straight segment of profile (position B of Fig.2) at which the central contact element 36b is substantially on the same axis as the two outer contact elements 36a.

Where there is a valley 34 (position A of Fig.2), the central contact element 36b protrudes outwards beyond the line joining the centres of the two outer contact elements 36a by a positive value $1'$; the smaller the radius of curvature of the valley 34 is, the greater will be the value $1'$.

This enables the governing and control unit 27 to identify the presence of the valley 34, to evaluate the radius of curvature of the same and to increase the speed of rotation and/or the pressure of the operating element 32 in proportion to the shorter time of contact between the operating element 32 and the profile of the piece 11 to be honed.

Where there is a projection 35 (position C of Fig.2), the central contact element 36b is thrust inwards beyond that joining line by a negative value $1''$, which is a function of the radius of curvature of the projection 35.

In this case too the governing and control unit 27 can thus identify the presence of the projection 35 and can evaluate the radius of curvature thereof and will reduce proportionately the speed of rotation and/or the pressure of the operating element 32 to compensate the longer time of contact with the profile of the piece 11 to be honed.

The smaller the radius of curvature of the projection 35 is, that is to say, the greater the retraction of the central contact element 36b is, the greater the reduction of speed and/or pressure will be and may even reach the stoppage of the operating element 32.

Position D of Fig.2 indicates a great retraction $1'''$ corresponding to the presence of a pointed peak 35a, which, where there is no compensation of the speed, could even be removed by the action of the operating element 32.

The embodiments of Figs.6, 7a and 7b show a third feeler unit 217 which incorporates the functions of the first 117 and second 19 feeler units and enables the installation of at least one movable shaft in the honing machine 10 to be dispensed with.

In this example the third feeler unit 217 comprises a truncated-cone feeler element 20 associated with at least two rollers 42. These rollers 42 are arranged with their axes parallel to, and advantageously have the same height as, the straight generating line of the feeler element 20.

The rollers 42 are associated with relative supporting rod means 44, which cooperate with the upper and lower faces (the lower face is not shown in the figure) of

the feeler element 20 and are pivoted together substantially at the axis of rotation of the feeler element 20 and are resiliently constrained together by spring means 43.

Moreover, in this case the supporting rod means 44 are associated at their ends with sliders 45 associated with a rack 46.

Means are also included to limit the minimum 47 and maximum 48 travel of the sliders 45.

During movement of the piece 11 to be honed in contact with the feeler element 20, spring means 43 permit the rollers 42 to move at an angle towards or away from each other according to the type of the contact profile of the piece 11 to be honed.

In fact, the projections 35 and valleys 34 in the profile of the piece 11 to be honed cause displacements of the rollers 42; these displacements are resisted by the spring means 43 and consist respectively in a reciprocal approach of the rollers 42 (Fig.7a) defined by a first angle (α') and in a reciprocal distancing of the rollers 42 (Fig.7b) defined by a second angle (α'').

These reciprocal displacements are also a function of the radii of curvature of the projection 35 and valleys 34.

By associating at least one of the sliders 45 with an encoder it is possible to obtain the extent of such approach or distancing, to identify the presence of projections 35 and valleys 34 in the profile and to send such information to the governing and control unit 27, which can thus take action to adjust the honing action of the operating element 32 according to the criteria cited earlier.

In this case the first processing assembly 16 can include the third feeler unit 217, whereas the other processing assemblies 16 located downstream will include the first feeler unit 117 as shown in Fig.5a for instance.

According to a variant, where the operating element 32 processes the piece 11 to be honed with its lower surface, means may be included to adjust the height of the operating element 32 so as to compensate the progressive wear thereof during the processing.

According to another variant, where the piece 11 to be honed is moved on a turntable, means are included to compensate the speed of rotation of the operating element 32 in proportion to its approach towards or distancing from the axis of rotation of the turntable 12 where such approach or distancing are caused by the conformation of the piece 11 to be honed and/or by the presence of valleys 34 or projections 35 in the profile of the piece 11. In fact, such approach and distancing determine a variation in the peripheral speed of the piece 11, and this variation has to be compensated.

Such compensation means (not shown here) consist, for instance, of a position sensor fitted directly, for instance, to the second movable carriage 28 associated with the operating element 32.

This position sensor can evaluate the position of the second movable carriage 28 in relation to the axis of

rotation of the turntable 12 and can act on the speed of rotation and/or pressure of the operating element 32 according to the identification of that distance.

According to another variant, where the operating element 32 consists of an abrasive belt fitted to rollers and cooperating, in the zone of contact, with a thrust pad which can rotate to suit itself to the profile of the piece 11 to be honed, the rotation of the thrust pad can be controlled and governed by the indications of the second feeler unit 19 of the type shown in Fig.2.

To be more exact, the second feeler unit 19 is able to identify directly the variations of inclination along the profile of the piece 11 to be honed in terms of the radius of curvature by reading, moment by moment, the variation of inclination of the line joining the centres of the outer contact elements 36a in relation to the movable shaft 39.

The variant of Fig.8 shows an embodiment which includes one single feeler unit 117 with a relative feeler element 20, which governs a plurality of operating elements 32.

In this example the feeler element 20 may have any conformation, cylindrical for instance, and the axial position of the feeler element 20 is advantageously kept stationary during the whole period of the processing.

According to the invention the governing and control unit 27, to which the feeler element 20 sends continuously the data relating to the profile of the piece 11 to be honed, comprises specific data processing means 49a able to act on the relative operating elements 32 so as to compensate the progressive wear thereof 32 by means of electronic data processing.

These data processing means 49a receive as input the wear parameters, whether the latter be pre-memorised or monitored continuously on the operating elements 32, and provide as output the correction parameters for actuation of the operating element 32 by acting, for instance on the relative displacement means 29 or on the speed of rotation or on the honing pressure applied by the operating element 32 itself.

According to another variant the governing and control unit 27 includes specific data processing means 49b able to detect, merely from the reading provided by the feeler element 20, the inclusion of projection 35 and valleys 34 on the profile of the piece 11 to be honed and to evaluate the relative radii of curvature thereof 34-35.

On the basis of these data the specific data processing means 49b provide as output, by means of electronic data processing, the correction parameters for actuation of the operating element 32 in terms of speed of rotation or honing pressure, for instance.

According to yet another variant the governing and control unit 27 includes specific data processing means 49c able to evaluate, merely from the reading of the profile monitored by the feeler element 20, the variation of the relative peripheral speed as between the piece 11 to be honed and the operating element 32.

According to this variation of peripheral speed and

in a manner analogous to that detailed above, the data processing means 49c condition, by means of electronic data processing, the actuation of the operating element 32 so as to ensure a constant and uniform honing action along the whole profile of the piece 11 to be honed.

According to the further variants shown in Figs.9 and 10 the profile-reader assembly 17 is of an optical type. In the example of Fig.9 this profile-reader assembly 17 consists of an ordered series 50 of optical sensors of a photoelectric cell type or of a laser type.

These optical sensors send out beams of light, which are intercepted by the profile of the piece 11 to be honed, this piece being set in relative movement, thus making possible the identification and reading of all the positions of that profile.

In the example of Fig.10 the profile of the piece 11 to be honed is read continuously by a telecamera 51.

The profile-reader assembly 17 of an optical type sends the data of the profile of the piece 11 to be honed to the governing and control unit 27, which conditions the actuation of the operating element 32.

In this case too the governing and control unit 27, according to possible evolutive variants, may include the specific data processing means 49a-49b and 49c so as to condition the actuation of the operating element 32 respectively according to the progressive wear of the same 32, according to the presence and conformation of projections 35 and valleys 34 along the profile or according to the variations of the relative peripheral speed as between the piece 11 to be honed and the operating element 32.

Claims

1. Honing machine to hone curved and shaped profiles belonging to furniture elements, which are advantageously of furniture of an antique style, such as surfaces of tables, mouldings of furniture or pictures, panels, doors of kitchen cupboards, seat elements, etc., the profile to be honed including at least one shaping with projections (35) and valleys (34) positioned close together, the machine comprising a turntable (12) to displace the piece (11) to be honed, this displacement means being suitable to bring into cooperation the whole profile of the piece (11) to be honed with at least one processing assembly (16) of the honing machine (10), each processing assembly (16) comprising at least one reader assembly (17) to read the profile and at least one operating unit (18) equipped with a honing tool (32) and a governing and control unit (27), the machine being characterised in that the honing tool (32) has at least one first inactive position distanced from the piece (11) to be honed and at least one second working position in contact with the moving piece (11) to be honed, each profile-reader assembly (17) being positioned in a determined spatial relationship with the relative operating unit (18), the profile-reader assembly (17) and the operating unit (18) being associated with the governing and control unit (27), means being also included for the automatic take-up of the wear of the honing tool (32) and for compensation of the intensity of the honing action of the honing tool (32) and being able to be associated with the conformation of the specific position of the profile of the piece (11) to be honed.
2. Honing machine as in Claim 1, which comprises a profile-reader assembly (17) for each operating unit (18).
3. Honing machine as in Claim 1, in which a profile-reader assembly (17) governs a plurality of operating units (18).
4. Honing machine as in any of Claims 1 to 3 inclusive, in which the means that compensate the wear of the honing tool (32) are governed by data banks containing experimental data of the wear of the specific honing tool (32).
5. Honing machine as in any of Claims 1 to 3 inclusive, in which the means that compensate the wear of the honing tool (32) are governed by means that perform continuous dimensional monitoring of the honing tool (32).
6. Honing machine as in any of Claims 1 to 5 inclusive, in which the means that compensate the wear of the honing tool (32) are governed by specific data processing means (49a) included in the governing and control unit (27) and associated with the profile-reader assembly (17).
7. Honing machine as in any of Claims 1 to 6 inclusive, in which the profile-reader assembly (17) comprises at least one first feeler unit (117) with a relative feeler element (20).
8. Honing machine as in Claim 7, in which the feeler element (20) is conformed substantially as a cone or truncated cone and cooperates with means that vary the diameter of the surface of contact with the piece (11) to be honed, these variation means being governed by means that compensate the wear of the honing tool (32).
9. Honing machine as in any of Claims 1 to 8 inclusive, in which the means to displace the piece (11) to be honed are of a turntable type, while the feeler element (20) and honing tool (32) move in directions substantially radial to the axis of rotation of the piece (11) to be honed.

10. Honing machine as in any of Claims 1 to 8 inclusive, in which the means to displace the piece (11) to be honed are of a linear type, while the feeler element (20) and honing tool (32) move in directions substantially perpendicular to the axis of feed of the piece (11) to be honed.
11. Honing machine as in any of Claims 1 to 6 inclusive, in which the profile-reader assembly (17) comprises optical sensor reading means (50) or telecamera reading means (51).
12. Honing machine as in any of Claims 1 to 11 inclusive, in which the honing tool (32) is an abrasive grinding wheel.
13. Honing machine as in any of Claims 1 to 11 inclusive, in which the honing tool (32) is an abrasive belt fitted to rollers.
14. Honing machine as in any of Claims 1 to 11 inclusive, in which the honing tool (32) is an abrasive belt fitted to rollers and cooperating at the vicinity of the zone of contact with a thrust pad.
15. Honing machine as in any of Claims 1 to 14 inclusive, in which the means that compensate the intensity of the honing action are governed by specific data processing means (49b) included in the governing and control unit (27) and associated with the profile-reader assembly (17), these specific data processing means (49b) being able to identify the inclusion of projections (35) and valleys (34) at a specific position of that profile and also to evaluate the relative radius of curvature of those projections (35) and valleys (34) and to take action according to that identification so as to reduce and increase respectively the speed of rotation and/or pressure of the honing tool (32) against the piece (11) to be honed.
16. Honing machine as in any of Claims 1 to 15 inclusive, which includes a second feeler unit (19) positioned at least upstream of the operating unit (18) of the first processing assembly (16).
17. Honing machine as in Claim 16, in which the first feeler unit (117) and the second feeler unit (19) are separate elements.
18. Honing machine as in Claim 16, in which one single feeler unit (217) incorporates the functions of the first (17) and second (19) feeler units.
19. Honing machine as in any of Claims 1 to 18 inclusive, which comprises specific data processing means (49c) included in the governing and control unit (27) and associated with the profile-reader assembly (17) and able to identify variations of the relative peripheral speed of the piece (11) to be honed in relation to the honing tool (32).
20. Honing machine as in Claim 19, in which the specific data processing means (49c) govern means that compensate the intensity of the honing action of the honing tool (32).
21. Use of the honing machine according to any of claims 1-20 in a honing method to hone curved and shaped profiles which belong to furniture elements, which are advantageously of furniture of an antique style, such as surfaces of tables, mouldings of furniture or pictures, panels, doors of kitchen cupboards, seat elements, etc., the profile to be honed of which includes at least one shaping with projections (35) and valleys (34) positioned close together, the method including a step of displacing the piece (11) on the turntable (12), a step of continuous identification and reading of each position of the profile of the piece (11) to be honed by means of the profile-reader assembly (17), a step for storage of the data relating to that profile position, and a step of transfer of such data to the operating unit (18) equipped with the honing tool (32) that performs the honing, with a resulting governing of the position of that operating unit (18) in relation to the piece (11) to be honed, this step of transfer of the data taking place with a delay after the step of identification and reading, this delay being a function of the circumferential position of the operating unit (18) in relation to the profile-reader assembly (17) and being a function of the relative speed of feed of the piece (11) to be honed in relation to honing tool (32), the method including also steps of automatic compensation of the wear of the honing tool (32) and steps of compensation of the intensity of the honing action of the operating unit (18), these compensation steps depending on the geometric and structural characteristics of the profile of the piece (11) to be honed, on the characteristics of the honing tool (32) and on the type of processing performed.
22. Use as in Claim 21, in which the reading of the profile of the piece (11) to be honed is carried out mechanically by employing a reader assembly (17) that includes a first feeler unit (117) with a relative feeler element (20).
23. Use as in Claim 21, in which the reading of the profile of the piece (11) to be honed is carried out optically by using a reader assembly (17) including optical identification and reading means (50-51).
24. Use as in Claims 21, 22 or 23, in which the step of automatic compensation of the wear is governed by

data banks of experimental values of wear of the honing tool (32).

25. Use as in Claims 21, 22 or 23, in which the step of automatic compensation of the wear is governed by means performing continuous dimensional monitoring of the honing tool (32). 5
26. Use as in any of claims 21-25, in which the step of automatic compensation of the wear of the honing tool (32) is associated with variations of the diameter of the surface of contact between the feeler element (20) and the profile of the piece (11) to be honed. 10
27. Use as in any of claims 21-26, in which the step of compensation of the intensity of the honing action depends compensation of the intensity of the honing action depends at least on the geometric data of the projections (35) and valleys (34) in the profile of the piece (11) to be honed. 15
28. Use as in Claim 27, in which the step of compensation of the honing action governs the speed of rotation of the honing tool (32). 20
29. Use as in Claim 27 or 28, in which the step of compensation of the honing action governs the pressure of the honing tool (32) against the profile of the piece (11) to be honed. 25
30. Use as in any of claims 21-29, in which the step of compensation of the honing action of the honing tool (32) depends on the variations of relative peripheral speed as between the piece (11) to be honed and the honing tool (32). 30

Patentansprüche

1. Honmaschine zur Feinbearbeitung gebogener und geformter Profile von Möbelementen, vorzugsweise für Stilmöbel, wie beispielsweise Tischplatten, Formleisten für Möbel oder Bilderrahmen, Paneele, Türen von Küchenschränken, Stuhlelemente und dergleichen, wobei das zu honende Profil wenigstens einen Formabschnitt mit aufeinanderfolgenden Bergen (35) und Tälern (34) hat und die Honmaschine einen Drehtisch (12) für die Bewegung des zu honenden Werkstücks (11) aufweist und die Bewegungseinrichtung dazu dient, daß gesamte Profil des zu honenden Werkstücks (11) in den Wirkungsbereich mit wenigstens einer Arbeitseinheit (16) der Honmaschine (10) zu bringen, wobei jede Arbeitseinheit (16) wenigstens eine Abfühleinrichtung (17) und wenigstens eine Bearbeitungseinrichtung (18) hat, die ein Bearbeitungselement (32) hat und mit einer Antriebs- und Steuerzentrale (27) verbunden ist, dadurch 40

gekennzeichnet, daß das Bearbeitungselement (32) mindestens eine erste Ruhestellung, die einen Abstand zu dem zu honenden Werkstück (11) aufweist, und wenigstens eine zweite, als Arbeitsposition dienende Stellung hat, in der es in Kontakt mit dem zu honenden, bewegten Werkstück (11) ist, wobei jede Abfühleinrichtung (17) für das Profil in einer determinierten, räumlichen Anordnung zu der zugehörigen Bearbeitungseinrichtung (18) ist, wobei ferner die Abfühleinrichtung (17) und die Bearbeitungseinrichtung (18) mit der Antriebs- und Steuerzentrale (27) verbunden sind und Mittel zur automatischen Aufholung der Abnutzung des Bearbeitungselementes (32) sowie Mittel zur Kompensation der Intensität der Schleifeinwirkung des Bearbeitungselementes (32) vorgesehen sind, die in Übereinstimmung bringbar sind mit der Ausbildung der jeweiligen Position des Profils des zu honenden Werkstücks (11).

2. Honmaschine nach Anspruch 1, dadurch gekennzeichnet, daß jeder Bearbeitungseinrichtung (18) eine Abfühleinrichtung (17) für das Profil zugeordnet ist.
3. Honmaschine nach Anspruch 1, dadurch gekennzeichnet, daß mehreren Bearbeitungseinrichtungen (18) eine Abfühleinrichtung (17) für das Profil zugeordnet ist.
4. Honmaschine nach einem der Ansprüche 1 bis 3, dadurch gekennzeichnet, daß die Mittel zur Kompensation der Abnutzung des Bearbeitungselementes (32) mit Datenbanken verbunden sind, welche experimentell ermittelte Daten über die Abnutzung des spezifischen Bearbeitungselementes (32) enthalten.
5. Honmaschine nach einem der Ansprüche 1 bis 3, dadurch gekennzeichnet, daß die Mittel zur Kompensation der Abnutzung des Bearbeitungselementes (32) durch Mittel zur kontinuierlichen Dimensionskontrolle des Bearbeitungselementes (32) gesteuert werden.
6. Honmaschine nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß die Mittel zur Kompensation der Abnutzung des Bearbeitungselementes (32) mit spezifischen Mitteln zur Datenauswertung (49a) verbunden sind, die in der Antriebs- und Steuerzentrale (27) vorgesehen und mit der Abfühleinrichtung (17) für das Profil verbunden sind.
7. Honmaschine nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß die Abfühleinrichtung (17) wenigstens eine erste Abtasteinheit (117) mit zugehörigem Abtastelement 55

(20) aufweist.

8. Honmaschine nach Anspruch 7, dadurch gekennzeichnet, daß das Abtastelement (20) eine im wesentlichen konische oder kegelstumpfförmige Ausbildung hat und Mittel zum Variieren des Durchmessers der Berührungsoberfläche mit dem zu honenden Werkstück (11) aufweist, welche mit den Mitteln zur Kompensation der Abnutzung des Bearbeitungselementes (32) verbunden sind. 5
9. Honmaschine nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß die Mittel für den Bewegungsvorschub des zu honenden Werkstücks (11) als ein Karussell ausgebildet sind und die Abtastelemente (20) sowie die Bearbeitungselemente (32) sich in im wesentlichen radialen Richtungen zur Drehachse des zu honenden Werkstücks (11) bewegen. 10
10. Honmaschine nach einem der Ansprüche 1 bis 8, dadurch gekennzeichnet, daß die Mittel für den Bewegungsvorschub des zu honenden Werkstücks (11) linear ausgebildet sind und sich die Abtastelemente (20) sowie die Bearbeitungselemente (32) in Richtungen bewegen, die im wesentlichen rechtwinklig zur Vorschubachse des zu honenden Werkstücks (11) verlaufen. 15
11. Honmaschine nach einem der Ansprüche 1 bis 6, dadurch gekennzeichnet, daß die Abfühleinrichtung (17) optische Mittel mit optischem Sensor (50) oder Fernsehkamera (51) aufweist. 20
12. Honmaschine nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß das Bearbeitungselement (32) als Schleifscheibe ausgebildet ist. 25
13. Honmaschine nach einem der Ansprüche 1 bis 11, dadurch gekennzeichnet, daß das Bearbeitungselement (32) ein über Rollen laufendes Schleifband ist. 30
14. Honmaschine nach einem der Ansprüche 1 bis 11, dadurch gekennzeichnet, daß das Bearbeitungselement (32) ein auf Rollen gelagertes Schleifband ist, das in der gesamten Berührungszone mit einem Druckschuh zusammenwirkt. 35
15. Honmaschine nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß die Mittel zur Kompensation der Intensität der Schleifwirkung mit spezifischen Mittel zur Datenverarbeitung (49b) verbunden sind, welche die Antriebs- und Steuerzentrale (27) aufweist und mit der Abfühleinrichtung (17) verbunden sind, wobei diese Mittel zur Datenverarbeitung (49b) so ausgebildet sind, daß sie die 40

Anwesenheit von Bergen (35) und Tälern (34) in einer bestimmten Position des Profils erkennen, den jeweiligen Krümmungsradius erfassen und in Abhängigkeit davon die Drehgeschwindigkeit und/oder den Druck des Bearbeitungselementes (32) auf das Werkstück (11) verringern bzw. vergrößern.

16. Honmaschine nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß wenigstens hinter der Bearbeitungseinrichtung (18) der ersten Arbeitseinheit (16) eine zweite Abtasteinheit (19) vorgesehen ist. 45
17. Honmaschine nach Anspruch 16, dadurch gekennzeichnet, daß die erste Abtasteinheit (117) und die zweite Abtasteinheit (19) voneinander verschiedene Elemente sind. 50
18. Honmaschine nach Anspruch 16, dadurch gekennzeichnet, daß eine einzige Abtasteinheit (217) die Funktionen sowohl der ersten Abtasteinheit (117) als auch der zweiten Abtasteinheit (19) in sich vereinigt. 55
19. Honmaschine nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß diese spezifische Mittel zur Datenverarbeitung (49c) aufweist, die in der Antriebs- und Steuerzentrale (27) enthalten und mit der Abfühleinrichtung (17) verbunden sind und die Veränderungen der relativen Umfangsgeschwindigkeit des zu honenden Werkstücks (11) bezüglich des Bearbeitungselementes (32) erkennen.
20. Honmaschine nach Anspruch 19, dadurch gekennzeichnet, daß die spezifischen Mittel zur Datenverarbeitung (49c) die Mittel zur Kompensation der Intensität der Schleifwirkung des Bearbeitungselementes (32) steuern.
21. Verwendung der Honmaschine nach einem der vorhergehenden Ansprüche in einem Verfahren zur Feinbearbeitung von gebogenen und geformten Profilen für Möbelemente, vorzugsweise Stilmöbel, wie beispielsweise Tischplatten, Formleisten für Möbel oder Bilderrahmen, Paneele, Türen von Küchenschränken, Stuhlelemente oder dergleichen, wobei das zu honende Profil wenigstens einen Formabschnitt mit eng nebeneinanderliegenden Bergen (35) und Tälern (34) hat, wobei das Verfahren umfaßt eine Phase für die Bewegung des Werkstücks (11) auf einem Drehtisch (12), eine Phase zum kontinuierlichen Erfassen und Erkennen jeder Position des Profils des jeweils zu honenden Werkstücks (11) mit Hilfe einer Abfühleinrichtung (17), eine Phase zur Speicherung der dem Profil und der Position entsprechen-

- den Daten, eine Phase zur Übertragung dieser Daten an eine Bearbeitungseinrichtung (18), die ein entsprechendes Bearbeitungselement (32) zum Honen aufweist, wodurch die Position dieser Bearbeitungseinrichtung (18) relativ zu dem zu honenden Werkstück (11) gesteuert wird und diese Phase der Datenübertragung nach der Phase der Positionserfassung mit einer Zeitverzögerung stattfindet, die eine Funktion der Umfangsposition der Bearbeitungseinrichtung (18) relativ zu der Abfühleinrichtung (17) sowie der relativen Vorschubgeschwindigkeit des Werkstücks (11) bezüglich des Bearbeitungselementes (32) ist, wobei das Verfahren ferner aufweist Phasen zur automatischen Kompensation der Abnutzung des Bearbeitungselementes (32) sowie Phasen zur Kompensation der Intensität der Schleifeinwirkung der Bearbeitungseinrichtung (18), welche Kompensationsphasen von den geometrischen und strukturellen Eigenschaften des Profils des Werkstücks (11), den Eigenschaften des Bearbeitungselementes (32) und der Art der ausgeführten Bearbeitung abhängen.
22. Verwendung der Honmaschine nach Anspruch 21, dadurch gekennzeichnet, daß die Erfassung des Profils des zu honenden Werkstücks (11) mechanisch durchgeführt wird durch eine Abfühleinrichtung (17) mit einer ersten Abtasteinheit (117) und einem zugehörigen Abtastelement (20).
23. Verwendung der Honmaschine nach Anspruch 21, dadurch gekennzeichnet, daß die Erfassung der Profils des zu honenden Werkstücks (11) optisch durchgeführt wird mit Hilfe einer optischen Abfühleinrichtung (17), die optische Mittel (50, 51) zur Erkennung aufweist.
24. Verwendung der Honmaschine nach einem der Ansprüche 21 bis 23, dadurch gekennzeichnet, daß die Phase der automatischen Kompensation der Abnutzung mit Datenbanken gekoppelt ist, welche experimentell ermittelte Werte bezüglich der Abnutzung des Bearbeitungselementes (32) enthalten.
25. Verwendung der Honmaschine nach einem der Ansprüche 21 bis 23, dadurch gekennzeichnet, daß die Phase der automatischen Kompensation der Abnutzung mit Mitteln zur kontinuierlichen Dimensionskontrolle dem Bearbeitungselementes (32) verbunden ist.
26. Verwendung der Honmaschine nach einem der Ansprüche 21 bis 25, dadurch gekennzeichnet, daß die Phase der automatischen Kompensation der Abnutzung des Bearbeitungselementes (32) gekoppelt ist mit Durchmesseränderungen der Kontaktfläche zwischen dem Abtastelement (20)

und dem Profil des zu honenden Werkstücks (11).

27. Verwendung der Honmaschine nach einem der Ansprüche 21 bis 26, dadurch gekennzeichnet, daß die Phase der Kompensation der Intensität der Schleifeinwirkung abhängt von wenigstens den geometrischen Daten der Berge (35) und Täler (34) des Profils des zu honenden Werkstücks (11).
28. Verwendung der Honmaschine nach Anspruch 27, dadurch gekennzeichnet, daß die Phase der Kompensation der Schleifeinwirkung die Drehgeschwindigkeit des Bearbeitungselementes (32) steuert.
29. Verwendung der Honmaschine nach Anspruch 27 oder 28, dadurch gekennzeichnet, daß die Phase der Kompensation der Schleifeinwirkung den Druck des Bearbeitungselementes (32) auf das Profil des zu honenden Werkstücks (11) steuert.
30. Verwendung der Honmaschine nach einem der Ansprüche 21 bis 29, dadurch gekennzeichnet, daß die Phase der Kompensation der Schleifeinwirkung des Bearbeitungselementes (32) abhängt von den Änderungen der relativen Umfangsgeschwindigkeit zwischen dem zu honenden Werkstück (11) und dem Bearbeitungselement (32).

Revendications

1. Machine à polir destinée à polir des profils courbes et modelés appartenant à des éléments de mobilier, qui appartiennent avantageusement au mobilier de style ancien, tels que des surfaces de tables, des moulures de meuble ou des images, des panneaux, des portes de placards de cuisine, des éléments de siège, etc., le profil à polir comprenant au moins un profilage avec des saillies (35) et des creux (34) positionnés les uns près des autres, la machine comprenant un plateau tournant (12) destiné à déplacer la pièce (11) à polir, ce moyen de déplacement étant approprié pour amener en coopération l'ensemble du profil de la pièce (11) à polir avec au moins un ensemble d'usinage (16) de la machine à polir (10), chaque ensemble d'usinage (16) comprenant au moins un ensemble lecteur (17) destiné à lire le profil et au moins une unité d'exécution (18) équipée d'un outil de polissage (32) et une unité de commande et de régie (27), la machine étant caractérisée en ce que l'outil de polissage (32) a au moins une première position inactive distante de la pièce (11) à polir et au moins une seconde position de travail en contact avec la pièce mobile (11) à polir, chaque ensemble lecteur de profil (17) étant positionné selon une relation spatiale déterminée par rapport à l'unité d'exécution relative (18), l'ensemble lecteur de profil (17) et l'unité d'exécution (18) étant associés à l'unité de

- commande et de régie (27), des moyens étant également compris pour rattraper automatiquement l'usure de l'outil de polissage (32) et pour compenser l'intensité de l'action de polissage de l'outil de polissage (32), et étant capables d'être associés à la conformation de la position spécifique du profil de la pièce (11) à polir.
2. Machine à polir selon la revendication 1, qui comprend un ensemble lecteur de profil (17) pour chaque unité d'exécution (18). 10
 3. Machine à polir selon la revendication 1, dans laquelle un ensemble lecteur de profil (17) régit une pluralité d'unités d'exécution (18). 15
 4. Machine à polir selon l'une quelconque des revendications 1 à 3 comprise, dans laquelle les moyens qui compensent l'usure de l'outil de polissage (32) sont régis par des banques de données contenant des données expérimentales de l'usure de l'outil de polissage spécifique (32). 20
 5. Machine à polir selon l'une quelconque des revendications 1 à 3 comprise, dans laquelle les moyens qui compensent l'usure de l'outil de polissage (32) sont régis par des moyens qui effectuent un contrôle dimensionnel continu de l'outil de polissage (32). 25
 6. Machine à polir selon l'une quelconque des revendications 1 à 5 comprise, dans laquelle les moyens qui compensent l'usure de l'outil de polissage (32) sont régis par des moyens de traitement de données spécifiques (49a) compris dans l'unité de commande et de régie (27) et associés à l'ensemble lecteur de profil (17). 30
 7. Machine à polir selon l'une quelconque des revendications 1 à 6 comprise, dans laquelle l'ensemble lecteur de profil (17) comprend au moins une première unité palpeuse (117) avec un élément palpeur relatif (20). 40
 8. Machine à polir selon la revendication 7, dans laquelle l'élément palpeur (20) est conformé sensiblement comme un cône ou un tronc de cône, et coopère avec des moyens qui font varier le diamètre de la surface de contact avec la pièce (11) à polir, ces moyens de variation étant régis par les moyens qui compensent l'usure de l'outil de polissage (32). 45
 9. Machine à polir selon l'une quelconque des revendications 1 à 8 comprise, dans laquelle les moyens destinés à déplacer la pièce (11) à polir sont d'un type à plateau tournant, pendant que l'élément palpeur (20) et l'outil de polissage (32) se déplacent 50
 10. Machine à polir selon l'une quelconque des revendications 1 à 8 comprise, dans laquelle les moyens destinés à déplacer la pièce (11) à polir sont d'un type linéaire, pendant que l'élément palpeur (20) et l'outil de polissage (32) se déplacent dans des directions sensiblement perpendiculaires à l'axe d'amenée de la pièce (11) à polir. 55
 11. Machine à polir selon l'une quelconque des revendications 1 à 6 comprise, dans laquelle l'ensemble lecteur de profil (17) comprend des moyens de lecture à détecteur optique (50) ou des moyens de lecture à télécamera (51).
 12. Machine à polir selon l'une quelconque des revendications 1 à 11 comprise, dans laquelle l'outil de polissage (32) est une meule abrasive.
 13. Machine à polir selon l'une quelconque des revendications 1 à 11 comprise, dans laquelle l'outil de polissage (32) est une courroie abrasive montée sur des rouleaux.
 14. Machine à polir selon l'une quelconque des revendications 1 à 11 comprise, dans laquelle l'outil de polissage (32) est une courroie abrasive montée sur des rouleaux et coopérant au voisinage de la zone de contact avec un patin de poussée.
 15. Machine à polir selon l'une quelconque des revendications 1 à 14 comprise, dans laquelle les moyens qui compensent l'intensité de l'action de polissage sont régis par des moyens de traitement de données spécifiques (49b) compris dans l'unité de commande et de régie (27) et associés à l'ensemble lecteur de profil (17), ces moyens de traitement de données spécifiques (49b) étant capables d'identifier la présence des saillies (35) et des creux (34) à une position spécifique de ce profil et d'évaluer également le rayon de courbure relatif de ces saillies (35) et creux (34), et d'agir selon cette identification, de façon à réduire et à augmenter respectivement la vitesse de rotation et/ou la pression de l'outil de polissage (32) contre la pièce (11) à polir.
 16. Machine à polir selon l'une quelconque des revendications 1 à 15 comprise, qui comprend une seconde unité palpeuse (19) positionnée au moins en amont de l'unité d'exécution (18) du premier ensemble d'usinage (16).
 17. Machine à polir selon la revendication 16, dans laquelle la première unité palpeuse (117) et la seconde unité palpeuse (19) sont des éléments dis-

tincts.

18. Machine à polir selon la revendication 16, dans laquelle une seule unité palpeuse (217) incorpore les fonctions des première (17) et seconde (19) unités palpeuses.

19. Machine à polir selon l'une quelconque des revendications 1 à 18 comprise, qui comprend des moyens de traitement de données spécifiques (49c) compris dans l'unité de commande et de régie (27) et associés à l'ensemble lecteur de profil (17), et capables d'identifier les variations de la vitesse périphérique relative de la pièce (11) à polir par rapport à l'outil de polissage (32).

20. Machine à polir selon la revendication 19, dans laquelle les moyens de traitement de données spécifiques (49c) régissent les moyens qui compensent l'intensité de l'action de polissage de l'outil de polissage (32).

21. Utilisation de la machine à polir selon l'une quelconque des revendications 1 à 20, selon un procédé de polissage destiné à polir des profils courbes et modelés qui appartiennent à des éléments de mobilier, qui appartiennent avantageusement au mobilier de style ancien, tels que des surfaces de tables, des moulures de meuble ou des images, des panneaux, des portes de placards de cuisine, des éléments de siège, etc., dont le profil à polir comprend au moins un profilage avec des saillies (35) et des creux (34) positionnés les uns près des autres, le procédé comprenant une étape de déplacement de la pièce (11) à polir sur le plateau tournant (12), une étape d'identification et de lecture continues de chaque position du profil de la pièce (11) à polir au moyen de l'ensemble lecteur de profil (17), une étape de stockage des données concernant cette position du profil, et une étape de transfert de ces données à l'unité d'exécution (18) équipée de l'outil de polissage (32) qui effectue le polissage, avec une régie résultante de la position de cette unité d'exécution (18) par rapport à la pièce (11) à polir, cette étape de transfert des données ayant lieu avec un retard après l'étape d'identification et de lecture, ce retard étant une fonction de la position circonférentielle de l'unité d'exécution (18) par rapport à l'ensemble lecteur de profil (17) et étant une fonction de la vitesse d'amenée relative de la pièce (11) à polir par rapport à l'outil de polissage (32), le procédé comprenant également les étapes de compensation automatique de l'usure de l'outil de polissage (32) et les étapes de compensation de l'intensité de l'action de polissage de l'unité d'exécution (18), ces étapes de compensation dépendant des caractéristiques géométriques et structurelles du profil de la pièce (11) à polir, des

caractéristiques de l'outil de polissage (32) et du type d'usinage effectué.

22. Utilisation selon la revendication 21, dans laquelle la lecture du profil de la pièce (11) à polir est mise en oeuvre mécaniquement en utilisant un ensemble lecteur (17) qui comprend une première unité palpeuse (117) avec un élément palpeur relatif (20).

23. Utilisation selon la revendication 21, dans laquelle la lecture du profil de la pièce (11) à polir est mise en oeuvre optiquement en utilisant un ensemble lecteur (17) comprenant des moyens d'identification optique et de lecture (50-51).

24. Utilisation selon l'une des revendications 21, 22 ou 23, dans laquelle l'étape de compensation automatique de l'usure est régie par des banques de données de valeurs expérimentales de l'usure de l'outil de polissage (32).

25. Utilisation selon l'une des revendications 21, 22 ou 23, dans laquelle l'étape de compensation automatique de l'usure est régie par des moyens effectuant un contrôle dimensionnel continu de l'outil de polissage (32).

26. Utilisation selon l'une quelconque des revendications 21 à 25, dans laquelle l'étape de compensation automatique de l'usure de l'outil de polissage (32) est associée à des variations du diamètre de la surface de contact entre l'élément palpeur (20) et le profil de la pièce (11) à polir.

27. Utilisation selon l'une quelconque des revendications 21 à 26, dans laquelle l'étape de compensation de l'intensité de l'action de polissage dépend au moins des données géométriques des saillies (35) et des creux (34) dans le profil de la pièce (11) à polir.

28. Utilisation selon la revendication 27, dans laquelle l'étape de compensation de l'action de polissage régit la vitesse de rotation de l'outil de polissage (32).

29. Utilisation selon la revendication 27 ou 28, dans laquelle l'étape de compensation de l'action de polissage régit la pression de l'outil de polissage (32) contre le profil de la pièce (11) à polir.

30. Utilisation selon l'une quelconque des revendications 21 à 29, dans laquelle l'étape de compensation de l'action de polissage de l'outil de polissage (32) dépend des variations de la vitesse périphérique relative entre la pièce (11) à polir et l'outil de polissage (32).

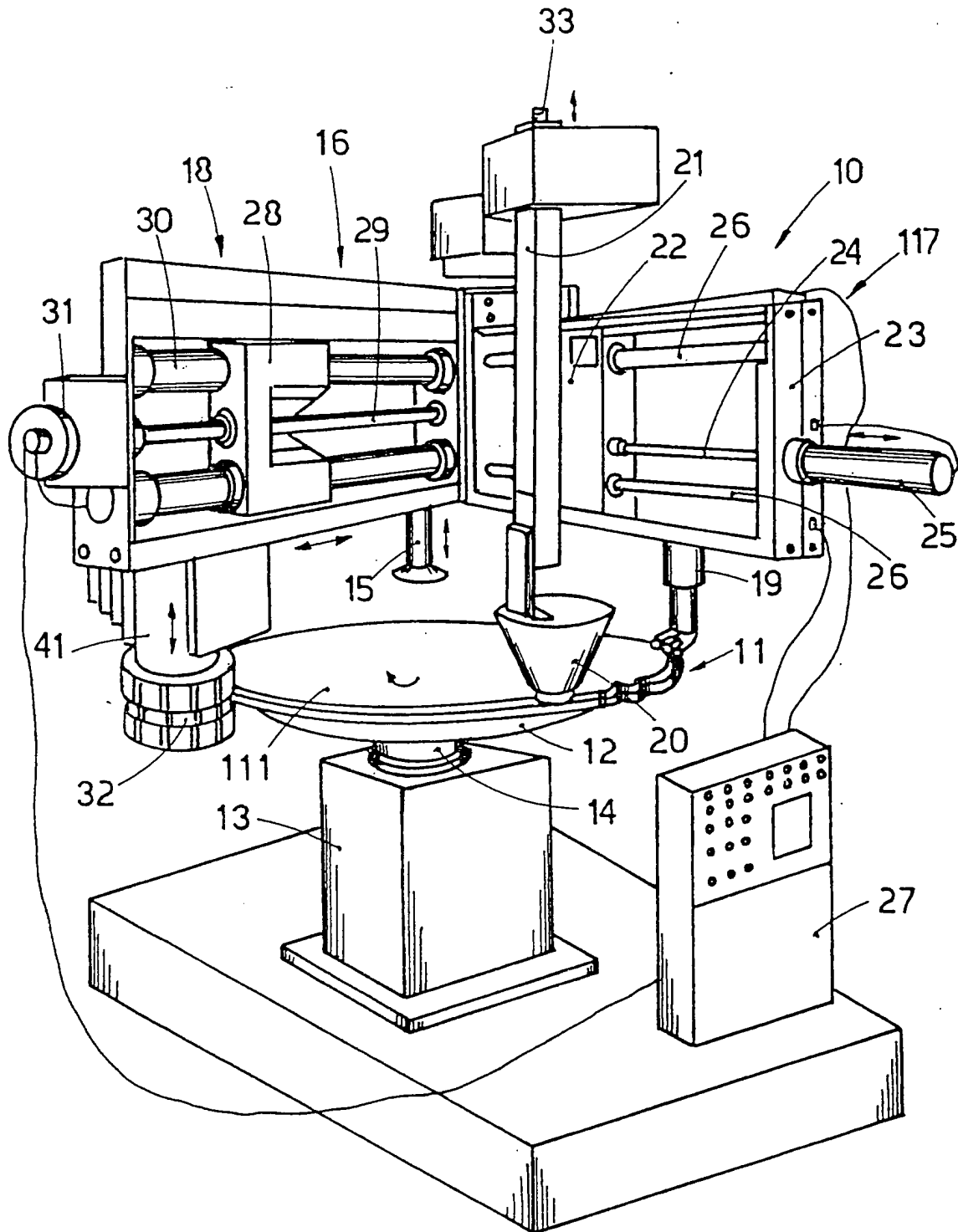


fig. 1

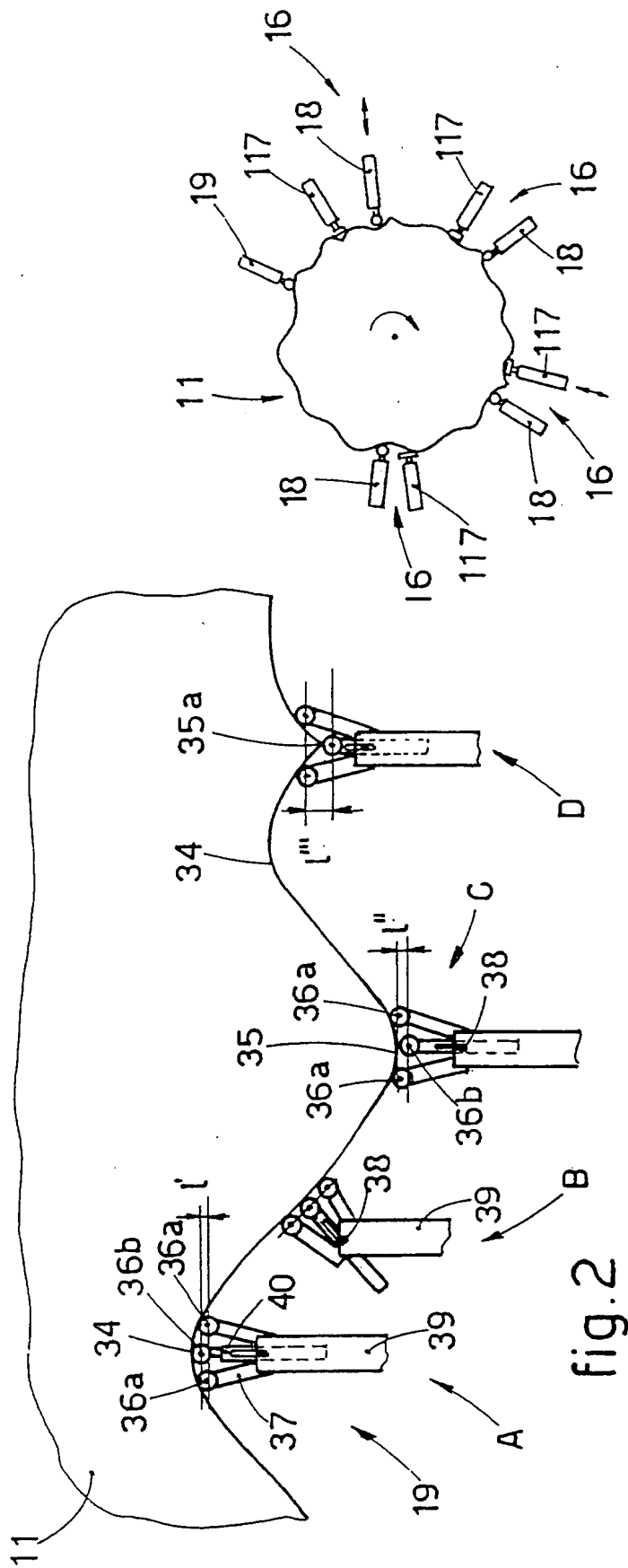


fig. 2

fig. 3

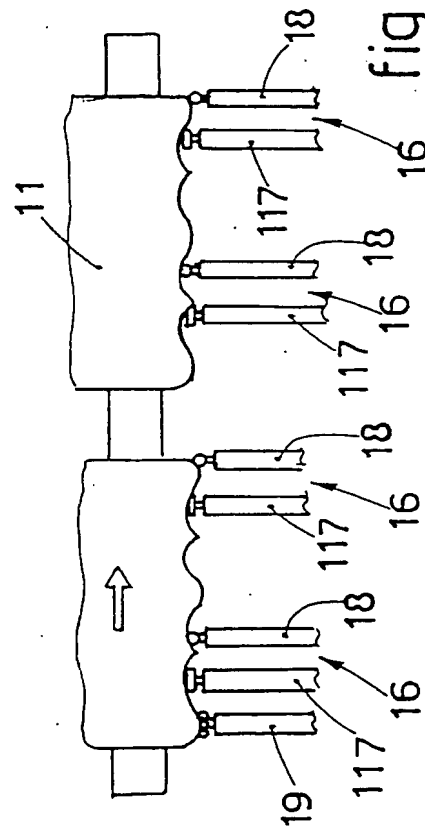
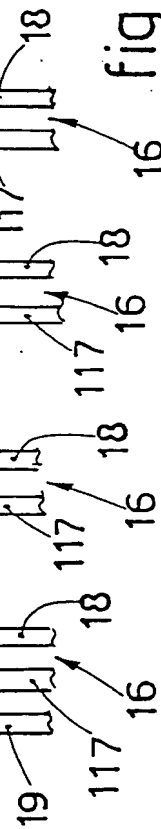


fig. 4



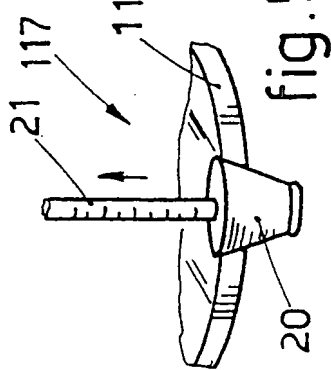


fig. 5a

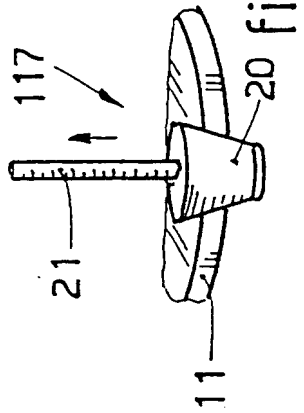


fig. 5b

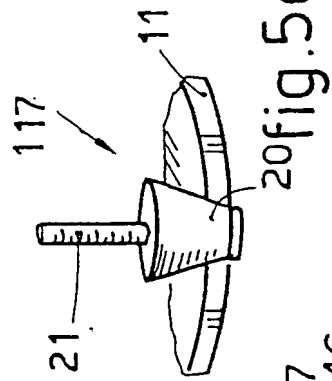


fig. 5c

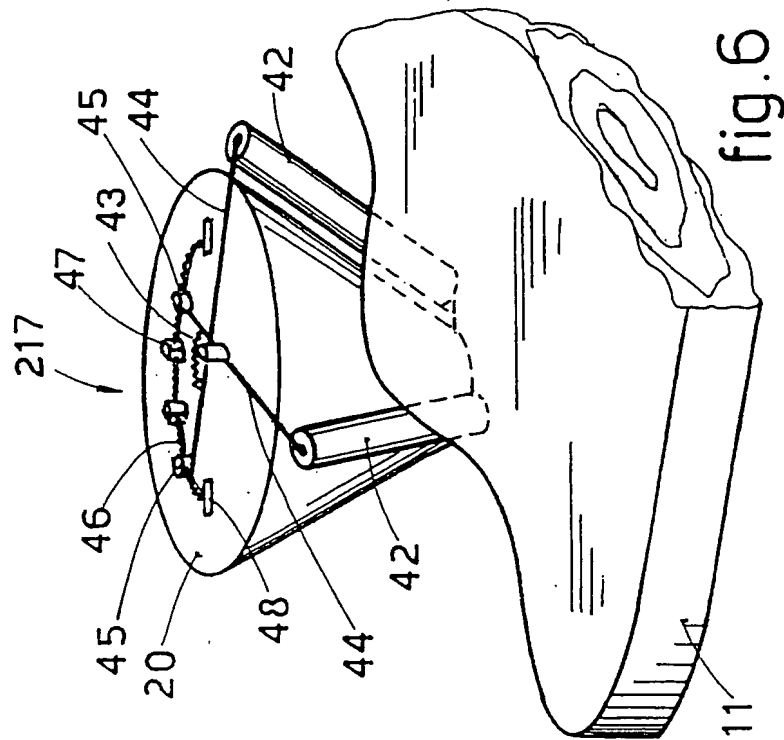


fig. 6

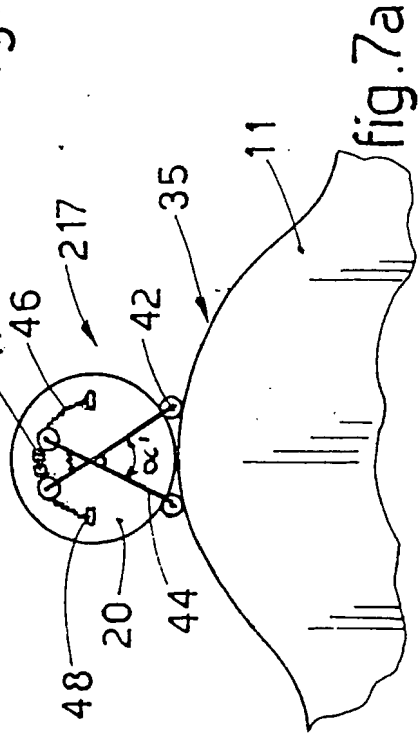


fig. 7a

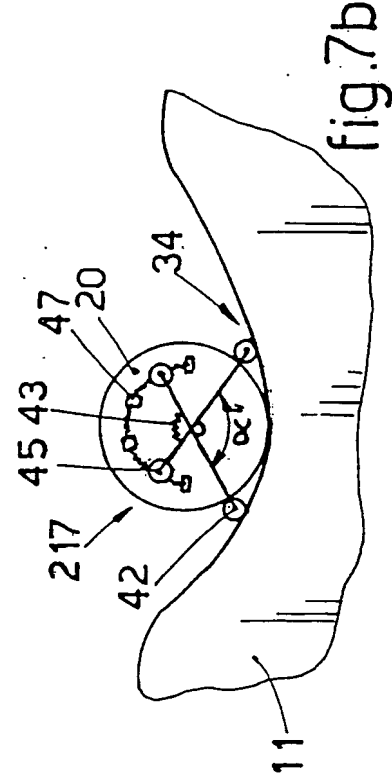


fig. 7b

